Project 4: Data Degradation

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CST-305: Principles of Modeling and Simulation

**Introduction**

Data degradation can be defined as gradual corruption of data due to the accumulation of noncritical failures in a data storage device. It’s important to understand the possible degradation of data because with this understanding it’s easier to prevent data loss or improve a data storage product. In this project, data degradation is modeled by blurring a photograph using gaussian blur in Python. When a photograph loses data over time, it’s blurred, and detail is lost. Blurring a photo is the best way to model this degradation in a visual way. Mathematically, a decay equation is modeled as an ODE, and the results are plotted using a graph.

**Necessary Packages**

Necessary packages for this project include numpy, odeint from scipy.integrate, matplotlib.pyplot, and sympy. These packages allow the code to calculate and plot an ODE.

A close up of a sign

Description automatically generated

**Project Background**

Data degradation happens over time in any digital data storage medium. There are a couple of factors that can affect this degradation:

The age of a hard drive is important when considering data degradation. The actual age of the hard drive doesn’t affect the degradation rate much, but the amount of times bits of data is read/written off of or onto the drive can be a negative effector on the drive’s longevity. As a bit of data gets overwritten multiple times, the hard drive begins to wear and will be unable to store more data in the same location.

Competing magnetic fields can also negatively affect a drive’s data retention. As the drive is made of metal components, any kind of magnetic contact can destroy data or corrupt bits. Stored data or data that is being written can be destroyed by any magnetic contact.

The temperature of a hard drive can also negatively affect a hard drive’s data retention. Heat can overheat the drive, and colder temperatures can cause a drive’s parts to perform less productively.

Any moisture issues within the drive’s enclosure can dramatically affect the health of a hard drive. Electrical problems can begin to arise if there’s any moisture in the drive.

**Mathematical Approach**

The mathematical approach for this project was modeled using a decay equation. The decay equation is exponential, and so is the degradation of a photo. To model this, the resolution and pixel density of the photo is found by the Python program, the photo is blurred, and the resolution is taken again. To mathematically model this, the equation is used:

is a constant in the equation that depicts the degradation of the photo. This is taken by finding the original resolution of the photo and subtracting it from the resolution of the blurred photo. is a function that helps identify the degradation by using the resolution of the photo.

**Mathematical Method in Code**

In our code, the equation is used after the value and function are identified using the model function. Afterwards, the odeint function is used to exemplify the values of degradation over time. The information from the odeint function is graphed with matplotlib.pyplot.

Opening the original photo to get dimensions:

A screenshot of a cell phone

Description automatically generatedApplying blur to the photo:

A picture containing table, screen, phone, display

Description automatically generated

The ODE to be plotted:

A picture containing meter, clock

Description automatically generated

Image comparison to accurately predict degradation rate:

A close up of a logo

Description automatically generated

Plotting the results:

A picture containing holding, player

Description automatically generated

**References**

Langtangen, H. (2012, December 13). Finite difference methods for first-order ODEs. Retrieved

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main\_decay.html